1053 Brevig Mission RPSU Power Plant Project
Completion Award for Denali Commission Project 23B
Final Closeout Summary Report October 2012

This Final Closeout Summary Report is filed with the federal grantor agency the Denali Commission ("Denali" or "DC") by its grantee partner Alaska Village Electric Cooperative, Inc. ("AVEC"). The federal grants addressed in this report and/or by this DC Energy Program project are: 0023-DC-2001-I5 and 0049-DC-2002-I2 (both of which funded Denali project 23B) and 1053. The project entailed the construction of a new modular utility-scale, diesel-fired electric power plant in Brevig Mission, Alaska. Award/project 1053 provides completion funding for the same project designated earlier as 23B.

An initial project closeout report for project 23B entitled "Award Transition and Closeout Summary Report" was submitted for this project on June 15, 2009. At the time, the project was still in construction under award 1053. That initial, transitional closeout report was necessary because funds allocated to this project from the earlier Denali awards 0023-DC-2001-I5 and 0049-DC-2002-I2 had been fully expended and the awards had expired and were being closed. However, at that time the project was still under construction under the completion award 1053. This final closeout report is being filed because the project is now complete and functioning, all funding awards have now been fully expended, and award 1053 has also expired and is being closed. No federal funds are available for de-obligation from any award on this project. Total project costs exceeded total project funding by $1,215,753; AVEC has paid the additional costs. This report represents the project status as of December 31, 2010.

Background

Brevig Mission, Alaska is located at the mouth of Shelman Creek on Port Clarence on the Bering Sea coast, 7 miles northwest of Teller and 65 miles northwest of Nome, well off the road system in the far western part of the state. It lies at approximately 65.334720° North Latitude and -166.489170° (West) Longitude (Sec. 09, T002S, R038W, Kateel River Meridian). Brevig Mission is located in the Cape Nome Recording District. The area encompasses about 3 square miles of land. Brevig Mission has a maritime climate with continental influences when the Bering Sea freezes.

AVEC was the grantee of DC funding for this project and is the sole project participant. As owner and operator of the new power plant, AVEC is responsible for future maintenance as well.

Activities

The scope for this project involved the design and construction of an eight-module, partially prefabricated, electric power generating plant, including site preparation, foundations, transformer platform and associated inter-connecting fuel piping and electrical wiring. The new power plant is supported by a "triodetic" steel frame foundation, and the overall site is a built-up gravel pad with embedded thermosiphons that remove heat and thereby protect the underlying permafrost.

This project was developed and built as part of an amalgamated energy facilities upgrade program for Brevig Mission, in conjunction with other Denali Commission projects, as follows: 1055 Bulk Fuel Upgrades (AVEC tank farm to support the power plant), 23A/1183 Bulk Fuel Storage Project (community tank farm), 23C/1184 Line Extension to Power Plant, and 70C/1302 Teller – Brevig Mission

Intertie. All of these projects except the intertie were built concurrently with the power plant; construction on the intertie began soon after the other four projects were completed.

Site and foundation design was performed by LCMF Consulting Engineers, now known as UMIAQ LLC. The generator and module design was performed by AVEC's Engineering Department. Site work, structural connections and the placement of the foundations, the modules, the interconnecting corridor and the transformer platform were performed by the construction manager CE2 Engineering ("CM" or "CE2"). AVEC Operations Department field crews completed the interconnections (electrical, fuel supply, etc.) between the modules, and set up and programmed the control systems.

The power generation facility upgrades, along with the other DC Energy Program projects for Brevig Mission, have undergone a number of program changes and shifts since the original concept design investigation for the community's energy facilities was funded by the Denali Commission in 2001. The initial concept included a new diesel-fired modular power plant to serve the electric power consumers in Brevig Mission only, but many obstacles surrounding site selection and control constrained development to the preliminary design phase. Questions about which local entity would own and which entity would operate a proposed, related DC Energy Program project (the multi-participant community bulk fuel tank farm) were debated for over two years; this delayed the power plant project because the amalgamated program concept called for constructing all DC Energy Program projects concurrently in order to reduce costs for each of them.

The design shifted in January 2005, with AVEC's purchase of the electric power utility in nearby Teller, Alaska (pop. 260, located about 7 miles south of Brevig Mission, across Grantley Harbor). The acquired, existing plant in Teller had sufficient capacity to power both villages if an intertie line were to be built to electrically connect the two villages. However, the existing generation units in Teller were installed between 1989 and 1997 and further evaluation revealed that the plant was due for major refurbishment or replacement. Further development of the Teller design was halted when it was determined that site control for a fuel storage tank farm to serve a power plant in Teller would take much longer than originally anticipated.

During these delays, the components procured to date for the Brevig Mission – Teller power plant were reassigned to another AVEC project being planned for Mekoryuk, Alaska (not physically, rather only in cost records), when it appeared that the Mekoryuk project would be ready for construction first. But anticipated funding constraints in 2008 led AVEC to develop a strategic plan to curtail long-range planning efforts and to commit available funds to complete the highest, most urgent priority projects already under development. As a result, the components procured to date were reassigned back to Brevig Mission, from Mekoryuk.

Three generators had originally been procured with a combined capacity of 835 kW, enough to serve Brevig Mission only. The later developments led to late-stage design changes which increased the new power plant's generation capacity enough to enable it to serve both villages' electrical power generation needs by amending the size of one of the smaller engines. One 236 kW generator was removed from the

design and replaced with a 505 kW generator, changing the power plant size to 1,104 kW. The outfitted modules were made ready for barge shipment in 2008.

Ground breaking for the project actually began in July 2008, with construction spanning two years. Again the project had unforeseen delays: during excavation in August, while preparing the planned gravel pad, the project team and its archaeologist discovered several sets of aged human remains in the work area. Site work was immediately suspended, the area was left undisturbed and the location for the new power plant was changed to a new, nearby site provided by the community. The new AVEC tank farm (project 1055) that stores the power plant's fuel, not yet in construction at the time, was then shifted north to avoid the discovered burial site, but was not moved to an entirely new location. The fuel supply line from the tank farm to the power plant had to be redesigned to run underneath the street which now separates the two facilities.

Some limited construction was continued during the redesign process, particularly civil work, but most field activity had to be suspended prematurely for the 2008 season. The human remains accidentally uncovered during construction were carefully exhumed, properly handled and repatriated to representatives of the Native Village of Brevig Mission (the recognized tribal entity for Brevig Mission), in accordance with the Native American Graves Protection and Repatriation Act of 1990.

The site change for the power plant required amendments to nearly all of the permits previously issued for the project and new geotechnical field studies and reconsideration of the site and foundation designs. Eventually, major design changes included the embedment of a flat loop thermosiphon system into the gravel pad (to maintain underlying permafrost in its historically frozen condition), and use of the pre-manufactured, open lattice, triodetic steel-frame foundation (which places the plant into a snow-drift configuration and raises it above snow-drift height at much lower cost than the alternative consisting of driven steel piles and structural steel).

Civil site work was recommenced in May 2009; the CM substantially completed its work in 2009, with AVEC crews working through the winter and spring of 2009 - 2010. The new power plant was commissioned on June 9, 2010. Excess land was reconveyed to the City of Brevig Mission in early 2011 after approval of a replat and lot division by the appropriate recording authorities.

The new power plant consists of eight modules, all of them 11' wide and 30' long. Three of these are generation modules, each housing a generator set with the following diesel engines: a Detroit Diesel S60K4-1200 (236 kW), a Detroit Diesel S60K4-1800 (363 kW) and a Caterpillar 3456 (505 kW); total generating capacity is 1,104 kW. Each generation module is equipped with its own separate systems for cooling, engine exhaust, engine preheat, lighting, ventilation, space heating, fire suppression, fuel supply, DC power supply, gantry and certain controls. A fourth module houses switchgear equipment and the remainder of the controls. The other four modules are support modules consisting of: one cold storage module, one warm storage module, one lubricating oil storage module and one living quarter module for use by itinerant generation and distribution workers. An enclosed center corridor, measuring approx. 74'

long and 10' wide, connects the eight modules. Attached to the plant are eight 100 kVA pad-mounted transformers.

Earlier concepts envisioned the new power plant being built next to the water treatment plant, which could have been an appropriate recipient for potential recovered heat from the power plant. Concerns about snow drifting in that location, the power plant's expected noise, the storage of bulk fuel near the center of the community, and the need for expanded fuel storage capacity to cover the needs of both communities, all led to a new planned location near the edge of town and further from any appropriate recovered heat recipient. In addition, the new power plant runs more efficiently than older plants and thus produces less recoverable heat to begin with. Once the plant was moved, the amount of recoverable heat could no longer justify the system infrastructure that would be necessary – particularly the additional length of heat transfer lines – to carry recovered heat to the water treatment plant (or other recipient). Heat recovery systems were deemed no longer economically viable, and not included in the design.

Funding, Costs and Cost Containment

Funding to date has been provided by Denali Commission grants to AVEC, and matching cash contributions from AVEC, shown as follows:

Funding and Costs: Project 1053 (and 23B) Brevig Mission RPSU Power Plant	Federal portion of award	AVEC match portion	Total All Sources
DC award 0023-DC-2001-I5	$ 94,783		$ 94,783
DC award 0049-DC-2002-I2	$ 1,560,706	$ 160,659	$ 1,721,365
DC award 1053	$ 1,052,372	$ 151,341	$ 1,203,713
Total Funding (Budget)	$ 2,707,861	$ 312,000	$ 3,019,861
DC award 0023-DC-2001-I5	$ 94,783		$ 94,783
DC award 0049-DC-2002-I2	$ 1,560,706	$ 160,659	$ 1,721,365
DC award 1053	$ 1,052,372	$ 151,341	$ 1,203,713
Costs not funded (cost overrun)		$ 1,215,753	$ 1,215,753
Total Actual Costs	$ 2,707,861	$ 1,527,753	$ 4,235,614
Costs in excess of funding			$ 1,215,753

Total costs ($ 4,235,614) exceed total formal funding ($ 3,019,861) by $ 1,215,753. Since no further federal funding or other funding is forthcoming, this shortfall is considered an additional AVEC match portion.

Design Generating Capacity	835 kW
Constructed Generating Capacity	1,104 kW

The completed, installed generating capacity exceeds the designed capacity.

Constructed cost per kW	$ 3,837 per kW
Denali Commission benchmark range	$ 1,250 to $ 1,600 per kW

The completed cost per kW of generating capacity exceeds the Denali Commission cost containment benchmark in place at the time by $ 2,237 per kW or 140%.

Problems Encountered/Lessons Learned

The many program changes brought about by the Brevig-Teller group of projects and AVEC's desire to electrically intertie the two communities in the most cost effective way, resulted in 6 years of planning, design, redesign, and procurement before actual construction of the amalgamated program of Brevig Mission energy facilities upgrades could be started. Even once major procurement was well underway, the project was delayed another year with yet another program change forced by loss of site control in Teller. During this time, commodity prices increased substantially for most of the primary materials (steel, copper, aluminum) used extensively in this sort of facility. The accumulated result was a substantial loss of time and increase in costs. However, this eventual outcome could not have been foreseen, caused by events beyond the control of DC and AVEC and any of the project's contractors.

The mid-project change of site location for the AVEC power plant and BFU, necessitated by the discovery and responsible handling of the human remains, raised costs and extended the project schedules for all Brevig Mission bulk fuel and power plant projects under the program. All parties worked quickly to accomplish the necessary redesign, and as close an adherence to the original project schedule, as possible.

The discovery of several sets of human remains only became evident after actual construction excavation began, even though the site had been walked and evaluated by a qualified archaeologist beforehand. Once they were discovered, all parties worked closely to ensure a smooth relocation to the new site, and to stay as close as possible to the original construction schedule. Still, additional costs and delays resulted from the required relocation.

Conclusions

In retrospect, the problems incurred may have been mitigated with a more exhaustive study of the final program concept. But even with that, the value received for the funding expended on this project is within acceptable limits and will improve the dependability and unit price for power to the AVEC customers in the villages of Brevig Mission and Teller. The completed project meets all current regulations and codes governing electrical generation facilities of this size.